

U.S.C.G. Merchant Marine Exam

Third Assistant Engineer

Q532 Motor Plants II

(Sample Examination)

Choose the best answer to the following Multiple-Choice Questions:

1. Compared to a naturally aspirated diesel engine, a supercharged diesel engine has _____.
- A. a cylinder air charge of higher pressure
 - B. reduced cylinder mean effective pressure
 - C. less valve overlap
 - D. reduced blow-by

Correct answer: A

2. In a naturally aspirated diesel engine, the volume of air intake is directly associated with engine _____.
- A. compression ratio
 - B. displacement
 - C. fuel pressure
 - D. cylinder clearance volume

Correct answer: B

3. A naturally aspirated diesel engine at full throttle will have an intake manifold pressure _____.
- A. slightly less than atmospheric pressure
 - B. constantly decreasing as engine load increases
 - C. approximately equal to exhaust manifold pressure at all times
 - D. that is widely fluctuating

Correct answer: A

4. Excessive wear at part No.11, shown in the illustration would result in _____. Illustration MO-0027
- A. Improper timing
 - B. Increased oil consumption
 - C. Lost compression
 - D. Low oil pressure

Correct answer: B

5. In a diesel engine exhaust system, the cooling of the exhaust gases below their dew point, will result in _____.
- A. increased engine back pressure
 - B. sulfuric acid corrosion
 - C. surface pitting of the turbocharger compressor blades
 - D. moisture impingement on the turbocharger compressor blading

Correct answer: B

6. Which of the listed characteristics is common to both wet and dry type diesel engine exhaust muffler systems?
- A. They function as spark arresters.
 - B. Both have a dust collecting chamber.
 - C. They never require any maintenance.
 - D. Both mufflers contain moving parts.

Correct answer: A

7. Wet-type exhaust silencers, that are used with some lifeboat diesel engines, utilize which design feature?
- A. The exhaust gases are preheated in the silencer to reduce noise.
 - B. A cooling water spray and internal baffles break up the exhaust gas flow.
 - C. The silencer is equipped with a water seal.
 - D. The exhaust temperature always increases when passing through the silencer.

Correct answer: B

8. A water jacket is placed around the exhaust manifolds of propulsion diesel engines to _____.
- A. Reduce heat radiation to the engine room
 - B. Aid in preventing turbocharger overheating
 - C. Condense and drain moisture from exhaust gases
 - D. Dampen exhaust gas pulsations in the manifold

Correct answer: A

9. In a diesel engine jacket water cooler, with sea water cooling the fresh water, the _____.
- A. Jacket water pressure must always be less than the sea water pressure
 - B. Sea water temperature must never be warmer than 40°F
 - C. Jacket water temperature must always be less than 60°F
 - D. Jacket water pressure should always be greater than the sea water pressure

Correct answer: D

10. In a diesel engine closed freshwater cooling system employing a radiator, proper water temperature can be obtained by _____.
- A. passing cooling water through the lube oil cooler
 - B. passing cooling water through a space heater
 - C. piping exhaust gases across the radiator front
 - D. adjusting the radiator louvers

Correct answer: D

11. Fuel injectors used in heavy fuel oil systems are usually provided with cooling to reduce _____.
- A. Cold corrosion of the nozzles
 - B. Fuel viscosity for better atomization
 - C. Carbon accumulation on the nozzles
 - D. Fuel detonation in the cylinders

Correct answer: C

12. In the engine shown in the illustration, the part labeled "W" is cooled by _____. Illustration MO-0003

- A. Air
- B. Convection
- C. Lube oil
- D. Sea water

Correct answer: D

13. What is the function of the item "7" shown in the illustration? Illustration MO-0111

- A. This jacket water pump supplies the distiller with sea water feed while also powering the eductors.
- B. This jacket water pump circulates salt water through the jacket water cooling system to provide engine cooling.
- C. This jacket water pump circulates fresh water throughout the engine cooling and distiller heating systems.
- D. This circulating saltwater pump will supply feedwater for the operation of the distiller.

Correct answer: C

14. Antifreeze solutions containing ethylene glycol should not be mixed with corrosion protection oils, as the resultant mixture _____.

- A. promotes scale buildup
- B. is dangerously flammable
- C. may cause frothing
- D. has a higher chloride content

Correct answer: C

15. Ethylene glycol, when used as a coolant in a closed cooling system for a diesel engine, is more advantageous than untreated raw water because it _____.

- A. Provides a constant pH below 7
- B. Has a lower freezing point and higher boiling point
- C. Has a higher freezing point and a lower boiling point
- D. Provides better vapor-phase cooling

Correct answer: B

16. Sacrificial zinc anodes are used on the saltwater side of diesel engine heat exchangers to _____.

- A. Reduce electrolytic action on heat exchanger metals
- B. Keep heat transfer surfaces shiny and clean
- C. Prevent rapid accumulation of marine growth
- D. Provide a protective coating on heat exchanger surfaces

Correct answer: A

17. What may cause a diesel engine cylinder head to crack?

- A. Overheated intake valves
- B. A leaking oil control ring
- C. Heat transfer from exhaust valves
- D. Scale on cooling passages

Correct answer: D

- 18.** Some diesel engines are fitted with a thermometer in the cooling water outlet from each cylinder. If the cooling water temperature from all cylinders begins to rise above normal, you should suspect _____.
- A. Incomplete combustion in all cylinders
 - B. Overloading in all cylinders
 - C. Increased blow-by in all cylinders
 - D. Insufficient fuel delivery to all cylinders

Correct answer: B

- 19.** The process of scavenging a two-stroke cycle diesel engine serves to _____.
- A. Improve fuel flow volume
 - B. Cool the exhaust valves
 - C. Reduce the intake air charge density
 - D. Increase the temperature of exhaust gases

Correct answer: B

- 20.** The average exhaust temperature of a two-stroke cycle diesel engine with a turbine-driven supercharger is lower than a similar four-stroke cycle diesel engine at equal loads because _____.
- A. Two-stroke cycle diesel engines have a higher M.E.P. than four-stroke cycle diesel engines
 - B. Four-stroke cycle diesel engine exhaust is cooled by scavenging air
 - C. Two-stroke cycle diesel engines have a lower M.E.P. than four-stroke cycle diesel engines
 - D. The opening of the two-stroke cycle diesel exhaust ports or valves occurs much later than in four-stroke cycle diesel engines

Correct answer: C

- 21.** Regarding the turbocharger shown in the illustration, the part labeled "B" would be attached to the _____ . Illustration MO-0228
- A. Aftercooler inlet
 - B. Exhaust manifold
 - C. Silencer outlet
 - D. Nozzle ring

Correct answer: A

- 22.** Which of the turbocharging methods listed directs the exhaust gases to the turbine at fairly uniform velocity and pressure?
- A. Constant pressure
 - B. Pulse pressure
 - C. Constant velocity
 - D. Axial flow

Correct answer: A

23. Which of the designs listed will keep the lobes from making contact in a Roots-type blower?

- A. Drive chain
- B. Blower timing gears
- C. Air trapped between blower lobes
- D. Oil filter between blower lobes

Correct answer: B

24. Air scavenging of the cylinder shown in the illustration begins between figures _____. Illustration MO-0025

- A. 2 and 3
- B. 3 and 4
- C. 4 and 5
- D. 5 and 6

Correct answer: B

25. While underway on a slow-speed propulsion diesel, the duty engineer is alerted to a high scavenging air temperature at one cylinder. Which of the following could be a possible cause?

- A. Exhaust valve leakage due to a burned seat.
- B. Scavenging air box fire at the piston underside.
- C. No water flow to the turbocharger after cooler.
- D. Blocked scavenging air cooler.

Correct answer: B

26. The power output of a turbo-charged diesel engine will drop if the cooling water flow through the after cooler is interrupted because the _____.

- A. Turbocharger stalls
- B. Exhaust pressure increases
- C. Air charge density decreases
- D. Scavenge effect increases

Correct answer: C

27. Clutching takes place nearest the bearing shown in the illustration, located at number _____. Illustration MO-0086

- A. 1
- B. 2
- C. 3
- D. 4

Correct answer: A

28. Which of the types of reduction gearing listed is best suited for medium-speed main propulsion units?

- A. Hypoid
- B. Helical
- C. Cyclical
- D. Spur

Correct answer: B

29. How is lubrication provided to the device shown in the illustration? Illustration MO-0120

- A. The lube oil enters through the supply pipes shown as #11 and eventually drains to the main engine sump.
- B. Only silicate ester based synthetic oils have the capability and necessary characteristics to be used in this type of application.
- C. A separate system containing oil under extremely high-pressure is used due to its ability to provide a high film strength.
- D. The lubrication system closely resembles the system used with standard line shaft bearings.

Correct answer: A

30. What is the normal bearing clearance permitted at the horizontal axis of the shaft for the bearing shown in the illustration? Illustration MO-0121

- A. The normal play on both sides of the shaft will be one tenth of a millimeter.
- B. The clearance on one side of the shaft at the axis will be one twentieth of a millimeter.
- C. The tolerances established are dependent on machining processes used and will vary amongst manufacturers.
- D. The clearance is determined by the thickness of the hydrodynamic wedge formed and is not usually measured while underway.

Correct answer: A

31. The gear drive, shown in the illustration, can have the backlash determined best by using a _____.
Illustration MO-0091

- A. Lead wire
- B. Lash indicator
- C. Red dye indicator
- D. Feeler gauge

Correct answer: D

- 32.** The pneumatic propulsion control system used on your vessel uses a diaphragm-operated relay valve as shown in the illustration. Periodically, the valve is to be disassembled for cleaning and inspection. What statement best describes the proper technique? Illustration MO-0052
- A. Rubber parts such as the diaphragm should be cleaned with non-flammable solvent, and metal parts such as the valve discs and seats should be washed with soap and water.
 - B. Rubber parts such as the diaphragm should be washed with soap and water, and metal parts such as the valve discs and seats should be cleaned with non-flammable solvent.
 - C. Rubber parts such as the diaphragm and metal parts such as the valve discs and seats should all be cleaned with non-flammable solvent.
 - D. Rubber parts such as the diaphragm and metal parts such as the valve discs and seats should all be washed with soap and water.

Correct answer: B

- 33.** The vessel to which you are assigned is fitted with a totally pneumatic propulsion control system as shown in the illustration. If propulsion control functions perfectly from the engine room control station, but will not function at all from any of the remote stations, which of the following system faults best accounts for these symptoms? Illustration MO-0168
- A. The attendance valve at the pneumatic remote-control station has a blocked outlet port.
 - B. The local/remote transfer valve at the engine room control station has a blocked local port.
 - C. The pilot house/remote transfer valve at the pilot house has a blocked remote port.
 - D. The local/remote transfer valve at the engine room control station has a blocked remote port.

Correct answer: D

- 34.** The function of the synchronizing motor on the generator governor illustrated is to _____. Illustration MO-0092
- A. drive the terminal shaft at a set speed
 - B. turn the governor drive shaft during start-up
 - C. provide remote control for speed adjustment
 - D. power the generator synchronizing lamps

Correct answer: C

- 35.** As the load is being decreased on the engine controlled by the governor shown in the illustration, the _____. Illustration MO-0092
- A. pilot valve plunger will move down
 - B. speeder rod will move down
 - C. right hand end of the floating lever will move up
 - D. oil pressure under the power piston will increase

Correct answer: C

- 36.** Using the oil chart provided in the illustration for guidance, which synthetic oil would be capable of providing adequate lubrication of the main engine speed control governor on your vessel, if the governor oil operating temperature shall be in the ideal operating range of 130oF to 205oF? Illustration MO-0161
- A. Amsoil 10W40 (Diester)
 - B. All Proof 10W50 (Polyolester)
 - C. Mobil 1 (Synthesized Hydrocarbon)
 - D. DN600 (Hydrocarbon)

Correct answer: B

- 37.** You are preparing to change the oil of the speed control governor on one of the main propulsion diesel engines on your vessel. What statement is true concerning the draining and flushing procedures?
- A. The governor oil should be drained while the oil is hot and the governor should be flushed with the heaviest grade of the same type of oil.
 - B. The governor oil should be drained while the oil is cold and the governor should be flushed with the lightest grade of the same type of oil.
 - C. The governor oil should be drained while the oil is hot and the governor should be flushed with the lightest grade of the same type of oil.
 - D. The governor oil should be drained while the oil is cold and the governor should be flushed with the heaviest grade of the same type of oil.

Correct answer: C

- 38.** Adjustments to the compensating needle valve in a hydraulic governor should be made with the engine at _____.
- A. Maximum power at a normal load
 - B. Maximum power and load under normal conditions
 - C. Half-speed and normal temperature
 - D. Normal operating temperature without a load

Correct answer: D

- 39.** The hunting of a diesel engine may be caused by which of the following?
- A. Excessive speed droop
 - B. Poor quality fuel
 - C. Fluctuations in load
 - D. Excessive governor control

Correct answer: D

- 40.** A diesel engine overspeeds and fails to restart when cranked at normal speed. Which of the following problems is the most likely cause for the engine failing to restart?
- A. Improper governor operation due to excess oil pressure
 - B. Damage to the governor due to excessive speed
 - C. Failure to reset the overspeed trip
 - D. Failure to reposition the fuel rack

Correct answer: C

- 41.** The governor utilized with the device shown in the illustration has become inoperative while the vessel is underway at sea. Which of the following statements describes what action should be taken? Illustration MO-0119
- A. It is necessary to disconnect the shuttle valve from the throttle lever horizontal bar, in order to effectively jump out the pneumatic engine enable control circuit.
 - B. The governor should be replaced with one that has been proven to be useful in isochronous applications.
 - C. The engine speed can be controlled using the fuel control lever without changing the position of the maximum fuel stop.
 - D. The linkage to the shutdown servomotor and the governor output shaft must be disconnected in order to operate the engine via the fuel control lever.

Correct answer: C

- 42.** With reference to the chart, if a boiler generates saturated steam at 385.3 psig, how much heat per pound was required to change the water into steam if the feedwater temperature was initially 220°F? Illustration SG-0004
- A. 96.85 BTU
 - B. 97.15 BTU
 - C. 1016.40 BTU
 - D. 1196.45 BTU

Correct answer: C

- 43.** When vapor is in contact with and remains at the same temperature as the boiling liquid from which it was generated, the vapor and liquid are said to be in which of the following?
- A. sensible contact
 - B. saturated condition
 - C. latent contact
 - D. critical state

Correct answer: B

- 44.** Assume that steam has formed in a boiler in which all of the steam stop valves are closed, and the water level is held constant. When there is an increase in the temperature of the steam and water in the boiler, which of the following effects will occur on the pressure and the specific volume of the steam?
- A. The pressure will increase and the volume will remain constant.
 - B. The steam pressure and volume will remain constant.
 - C. The pressure will remain constant and the volume will increase.
 - D. The pressure will increase and the specific volume will decrease.

Correct answer: D

- 45.** The auxiliary steam boiler on your vessel is equipped with a gauge glass for local level indication. On which of the following auxiliary boiler types would this gauge glass be attached to a flash chamber also known as a steam accumulator or steam separator?
- A. Water-tube forced-circulation steam boiler
 - B. Fire-tube steam boiler
 - C. Water-tube natural-circulation steam boiler
 - D. Electric steam boiler

Correct answer: A

- 46.** On which of the following auxiliary boiler types would soot blowers be equipped for maintaining heat transfer efficiency?
- A. Electric steam boiler
 - B. Fire-tube steam boiler
 - C. Water-tube natural-circulation steam boiler
 - D. Water-tube forced-circulation steam boiler

Correct answer: C

- 47.** The rate of heat transfer in a waste-heat boiler can be increased by _____.
- A. Operating the boiler at less than normal water level
 - B. Increasing the amount of excess air to the burners
 - C. Installing fins on the firesides of water-tubes
 - D. Treating the boiler water with chemical oxygen scavengers

Correct answer: C

- 48.** Fusible plugs are installed in fire-tube boilers to _____.
- A. Provide a means of draining the boiler
 - B. Cool the crown sheet at high firing rates
 - C. Warn the engineer of low water level
 - D. Open the burners' electrical firing circuits

Correct answer: C

- 49.** Which of the automatic boiler controls listed should be tested prior to lighting off an auxiliary boiler?
- A. Automatic bottom blow valve
 - B. Voltage output of the ignition transformer
 - C. Low water level cutoff switch
 - D. Insulation resistance readings in the ignition system high tension leads

Correct answer: C

- 50.** Which of the following actions takes place in the control circuit of an automatically fired auxiliary boiler when the desired steam pressure is obtained?
- A. A temperature sensing device opens the circuit breaker in the burner motor.
 - B. The stack relay actuates the low limit control which breaks the ignition circuit.
 - C. The high limit control secures power to the entire oil firing system.
 - D. The stack relay secures power to the high voltage side of the ignition transformer.

Correct answer: C

- 51.** A variable capacity, pressure atomizing, fuel oil burner functions to _____.
- A. maintain a constant fuel temperature
 - B. provide a constant fuel return pressure
 - C. provide a wide range of combustion
 - D. maintain smokeless fuel oil atomization

Correct answer: C

- 52.** Which of the following statements describes how the fuel oil enters the whirling chambers of the sprayer plates used in an auxiliary boiler return flow fuel oil system?
- A. Through the outer barrel tube
 - B. Through the sprayer plate drilled passages
 - C. Through tangential slots in the sprayer plate
 - D. Through baffles in the orifice plate

Correct answer: C

- 53.** The water-tube natural-circulation steam boiler on your vessel is equipped with soot blowers for maintaining heat transfer efficiency. Which of the following statements best describes the conditions that must be met before tubes can be safely blown using the soot blowers?
- A. The boiler draft must be increased AND the boiler fires must be lit before tubes can be safely blown.
 - B. The boiler draft must be decreased AND the boiler fires must be lit before tubes can be safely blown.
 - C. The boiler draft must be decreased AND the boiler fires must be secured before tubes can be safely blown.
 - D. The boiler draft must be increased AND the boiler fires must be secured before tubes can be safely blown.

Correct answer: A

- 54.** If the water level as indicated by the gauge glass of an auxiliary boiler is in question, it should be blown down. Which of the following statements represents the proper procedure for performing a gauge glass blow down?
- A. The gauge glass should be blown down twice; first with the upper cut-out valve open and then with the lower cut-out valve open.
 - B. The gauge glass should be blown down twice; first with the lower cut-out valve open and then with the upper cut-out valve open.
 - C. The gauge glass should be blown down once with both the upper cut-out and lower cut-out valves open simultaneously.
 - D. The gauge glass should be blown down once with the lower cut-out valve open.

Correct answer: B

55. On which of the following auxiliary boiler types would soot blowers most likely be fitted?

- A. Water-tube natural-circulation steam boiler
- B. Water-tube forced-circulation steam boiler
- C. Electric steam boiler
- D. Fire-tube steam boiler

Correct answer: A

56. What would be the most practical and efficient way of removing hard scale deposits from the water-sides of the tubes of an auxiliary fire-tube boiler?

- A. Use of a power-driven wire brush
- B. Use of an air lance
- C. Use of a high-pressure water jet
- D. Use of a suitable acid

Correct answer: D

57. On a vessel fitted with a coil-type, forced-circulation, water-tube, oil-fired auxiliary boiler, what is the most practical way of determining if the inside surface of the coil is excessively scaled with hard scale deposits?

- A. Measuring the coil inside diameter.
- B. Monitoring the circulating pump pressures.
- C. Monitoring the feed pump pressures.
- D. Performing a visual inspection.

Correct answer: B

58. You are observing the flame condition on an oil-fired auxiliary boiler through an observation window peephole. The flame is a reddish color accompanied by a noticeably panting/pulsating furnace. What would be the correlating color of the gases exhausting from the stack under these conditions?

- A. Dense black smoke
- B. Clear stack
- C. White smoke
- D. Light brown haze

Correct answer: A

59. Which of the following conditions could cause the feed pump for an auxiliary boiler to lose suction?

- A. Increased suction head pressure
- B. Decreased feedwater temperature
- C. Pump recirculating line being open too much
- D. Excessive feedwater temperature

Correct answer: D

- 60.** While preparing an engine for departure, the engineer notices water coming from both the waste heat boiler and turbocharger drains. Which of the following could be the cause?
- A. Leak in a waste heat boiler tube.
 - B. Leak from a turbocharger inlet casing.
 - C. Leak from a cylinder exhaust valve cage.
 - D. Leak in a turbocharger exhaust casing.

Correct answer: A

- 61.** As shown in the illustration, if the vessel was operating at full sea speed, the area labeled "L" would be used to _____. Illustration MO-0231
- A. Preheat the feedwater to the waste heat boiler
 - B. Collect stack gas
 - C. Collect steam and flash the heated water generated in area "B" into steam
 - D. Superheat the steam generated by the oil-fired mechanical burner

Correct answer: C

- 62.** Casing drains may be required on a waste heat boiler gas passage side to _____.
- A. prevent an accumulation of boiler water entering gas passages as a result of a pinhole tube leak
 - B. sample gases for testing
 - C. drain off condensation
 - D. release excess pressure

Correct answer: C

- 63.** The correct procedure for giving an auxiliary boiler a bottom blow, is to begin _____.
- A. when the boiler has been cooled to ambient temperature
 - B. only after raising the water level to within 1/2 inch of the high-water cutout
 - C. when the boiler has been secured long enough for most solids to settle
 - D. only after bypassing the low-pressure pressuretrol

Correct answer: C

- 64.** The most common cause of scale formation in an auxiliary boiler is _____.
- A. Improper treatment of the feedwater with calcium sulfate
 - B. Fuel oil in the feedwater
 - C. Concentrations of calcium sulfate in the boiler water
 - D. Excessive feedwater alkalinity

Correct answer: C

- 65.** When rolling over a main engine on your vessel prior to starting with the cylinder test valves open to expel any fluids accumulated within the cylinders, a rather large amount of water is discharged. What is the appropriate response?
- A. Start the engine, but run the engine with the cylinder test valves cracked slightly open.
 - B. Do not allow the engine to be started until the cause of the water discharge has been determined and corrected.
 - C. Start the engine, but maintain the jacket water expansion tank level higher than normal.
 - D. Start the engine, but monitor all fluid levels very closely, especially that of the jacket water.

Correct answer: B

- 66.** Which of the listed conditions could result in the failure of an auxiliary diesel engine to stop running when a normal shutdown is attempted?
- A. Supplying high temperature inlet air
 - B. Maintaining a high exhaust back pressure
 - C. Lube oil entering in the air intake manifold
 - D. Carbon buildup on the overspeed pawl

Correct answer: C

- 67.** The vessel to which you are assigned is gear-driven with one main propulsion diesel engine and a fixed-pitch propeller. While underway, the main engine becomes disabled, requiring your vessel to be towed back into port. If pressurized lubricating oil is not available to the reduction gear shaft bearings, what must be done during the towing operation?
- A. The reduction gear input shaft must be prevented from rotating by means of engaging the engine turning gear at the flywheel.
 - B. The reduction gear input and output shafts must be prevented from rotating by means of blocking the gear teeth.
 - C. The reduction gear output shaft must be prevented from rotating by means of locking the propeller shaft.
 - D. The reduction gear input shaft must be prevented from rotating by means of engaging the propulsion clutch.

Correct answer: C

- 68.** A main diesel engine on your vessel has experienced a safety shutdown due to excessive crankcase pressure. What is the appropriate response?
- A. Immediately restart the engine, and monitor the crankcase pressure to verify the cause of the shutdown.
 - B. Allow the engine to cool off for two minutes, then restart and monitor the crankcase pressure to verify the cause of the shutdown.
 - C. Immediately open the crankcase to make the necessary inspections to determine the cause of the high crankcase pressure safety shutdown.
 - D. Allow 2 hours for the engine to cool before opening the crankcase, and determine and correct the cause of the trip before attempting to restart the engine.

Correct answer: D

- 69.** An auxiliary diesel engine on your vessel has experienced a safety shutdown due to high lubricating oil temperature. What is the appropriate response?
- A. Allow the engine to cool off for two minutes, then restart and monitor the lubricating oil temperature to verify the cause of the shutdown.
 - B. Immediately restart the engine, and monitor the oil temperature to verify the cause of the shutdown.
 - C. Allow 2 hours for the engine to cool down before attempting to inspect the engine and correct the cause of the trip before attempting to restart the engine.
 - D. Immediately perform the engine inspections to determine the cause of the high oil temperature safety shutdown.

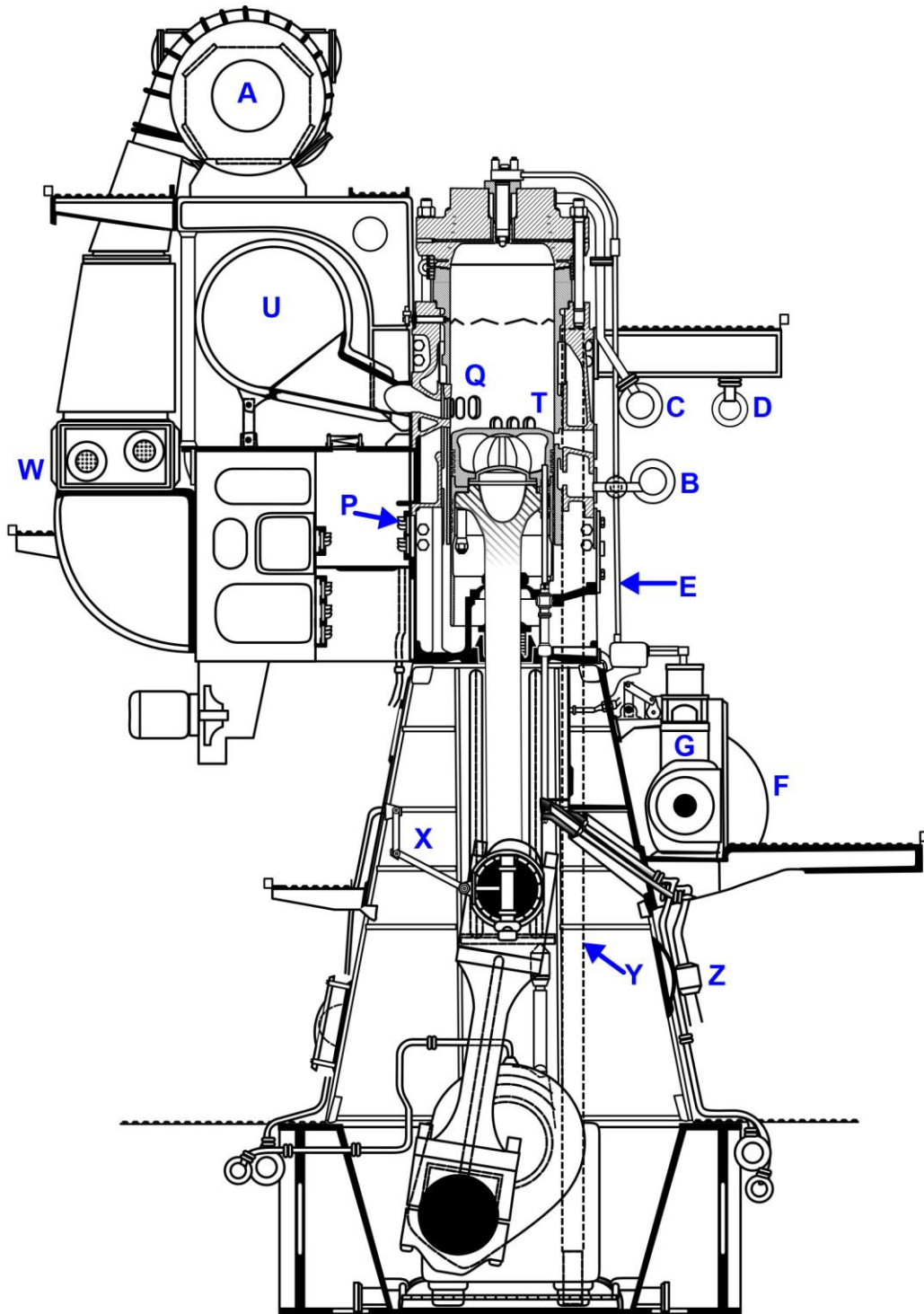
Correct answer: C

- 70.** Which of the listed items should be secured before performing any maintenance on a solenoid operated air start valve?
- A. Hydraulic switch and engage jacking gear
 - B. Lube oil standby pump and control air
 - C. Electric power and starting air
 - D. Motor drain and pneumatic control system power

Correct answer: C

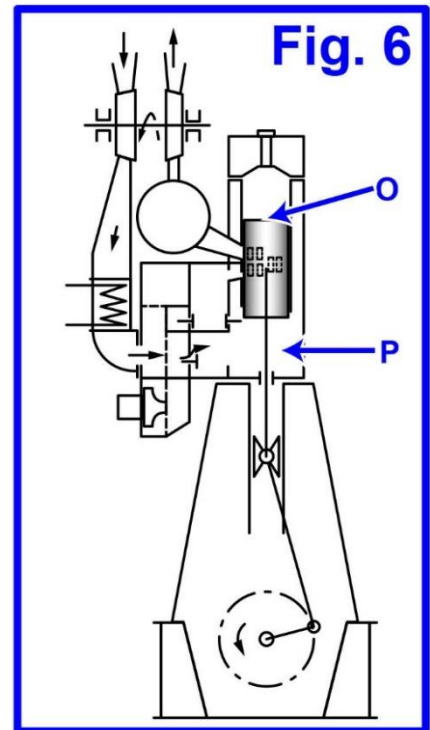
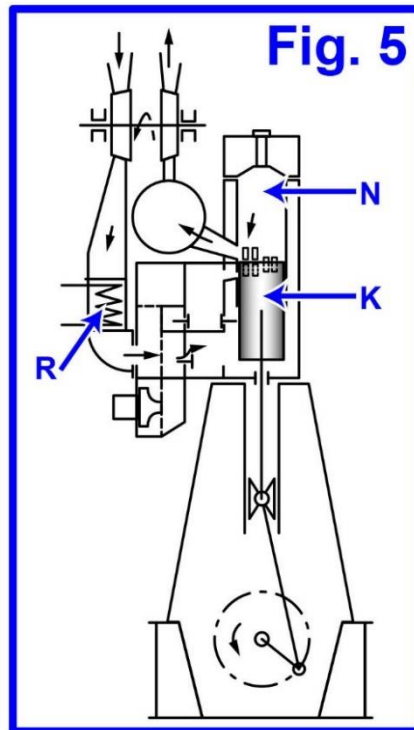
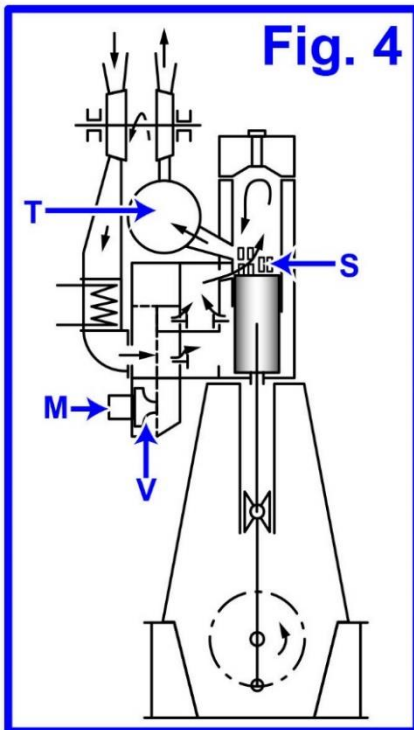
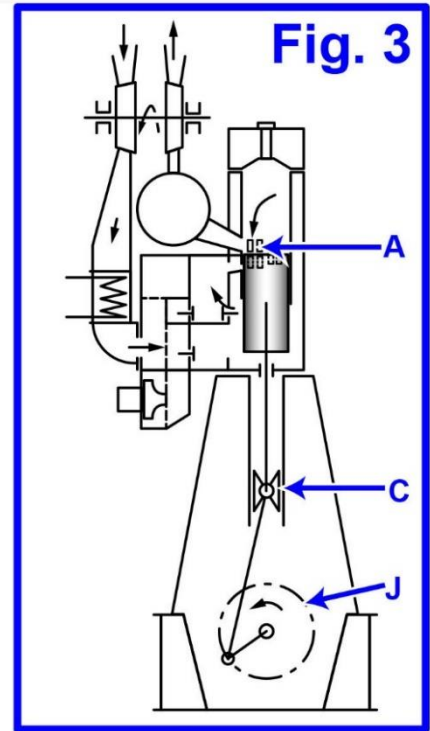
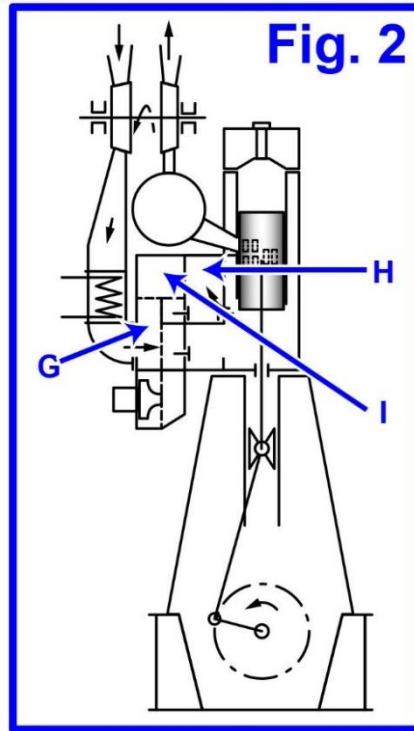
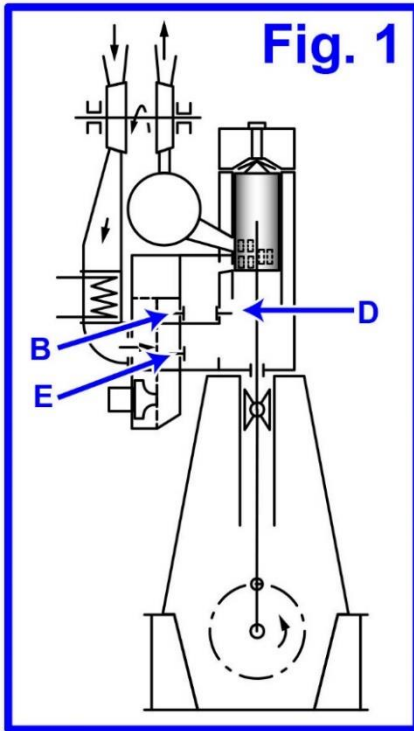


MO-0003



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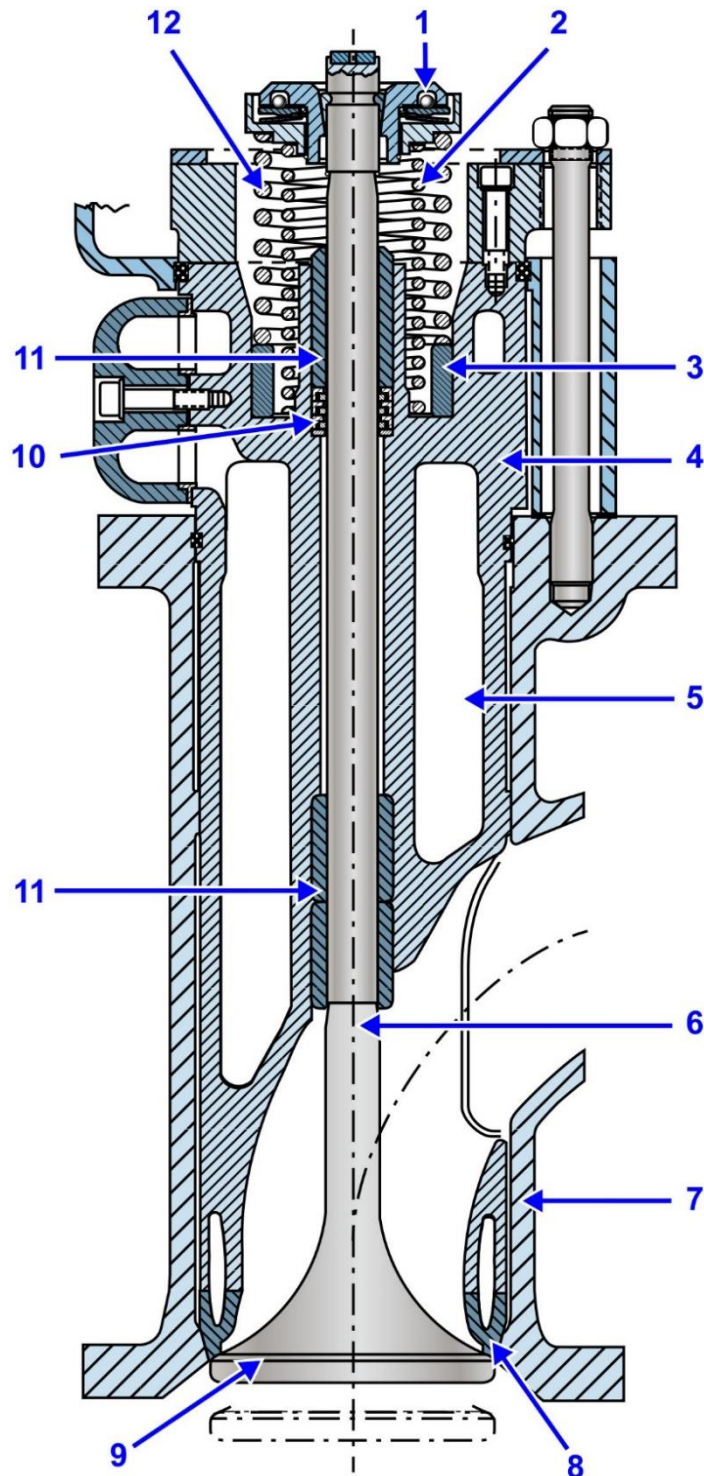
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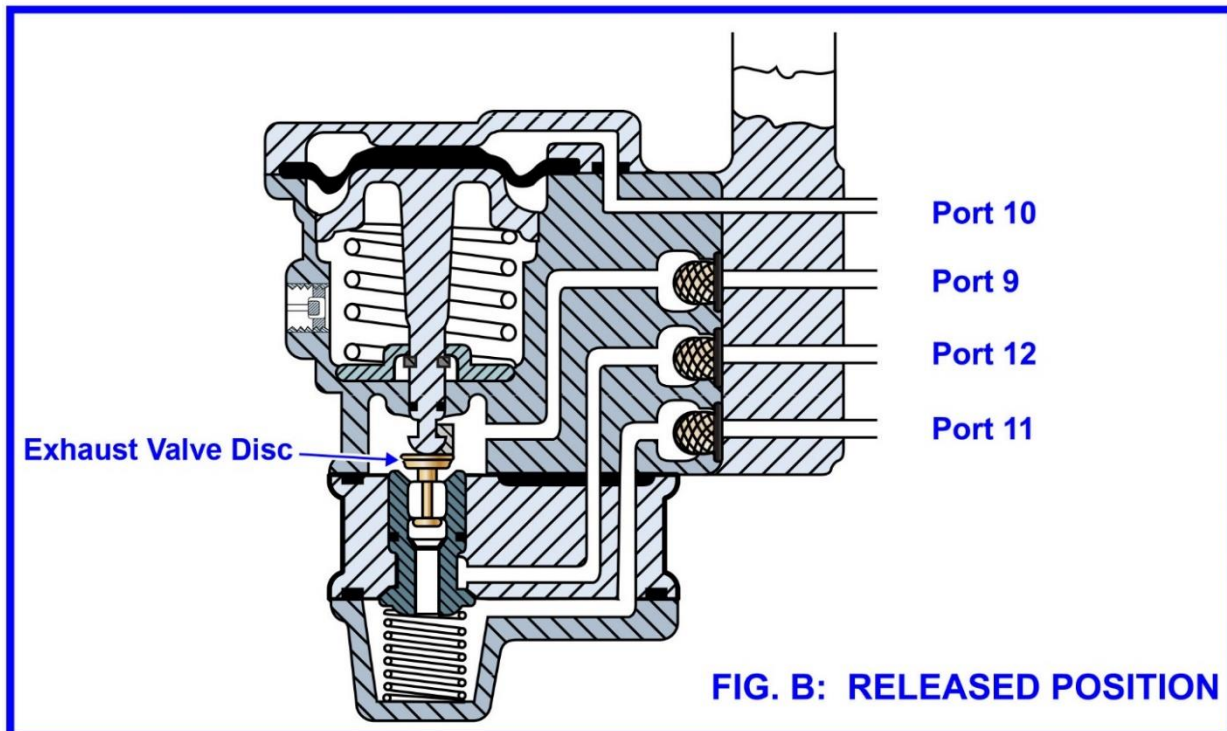
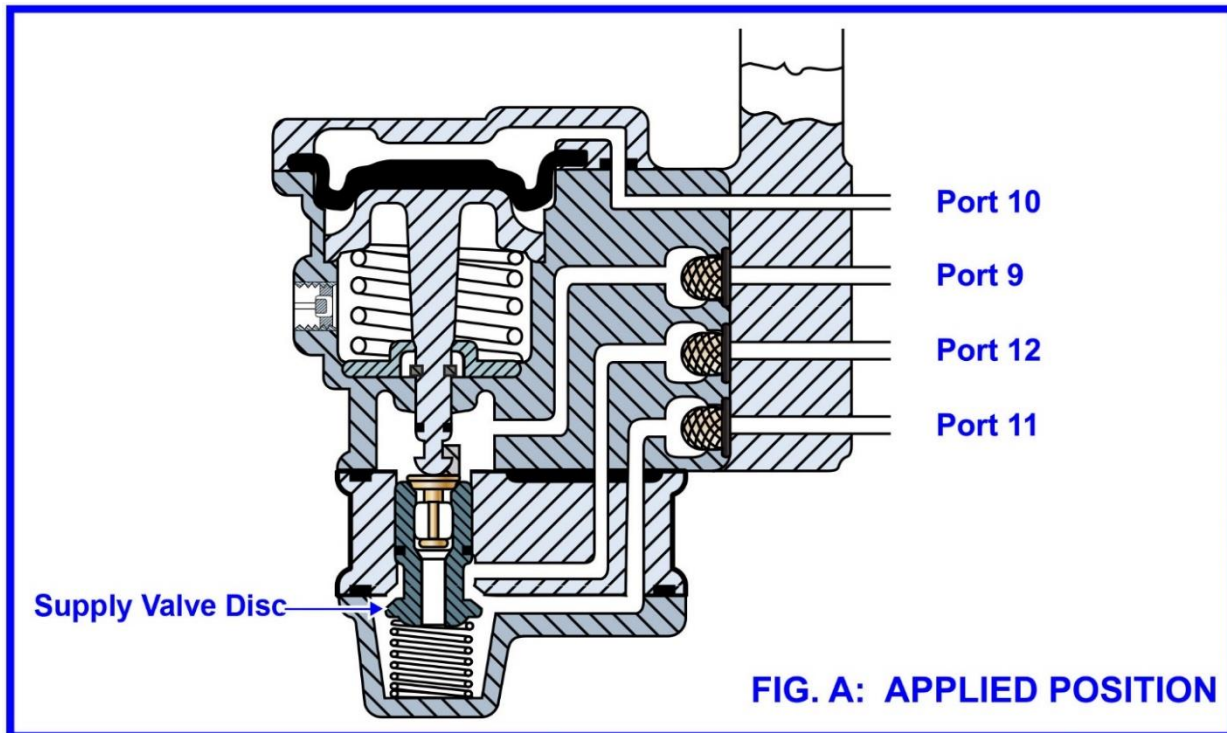
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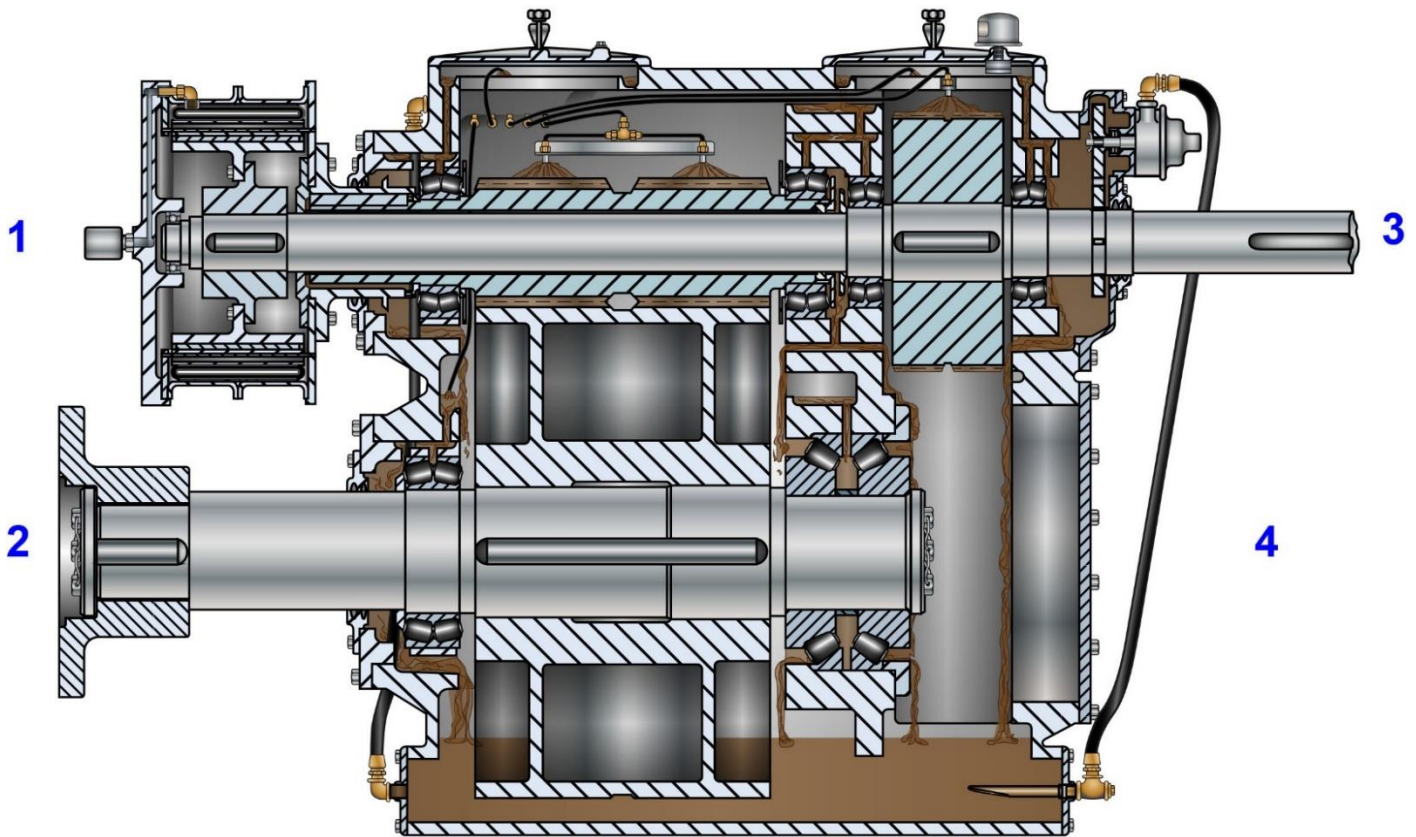
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MO-0086



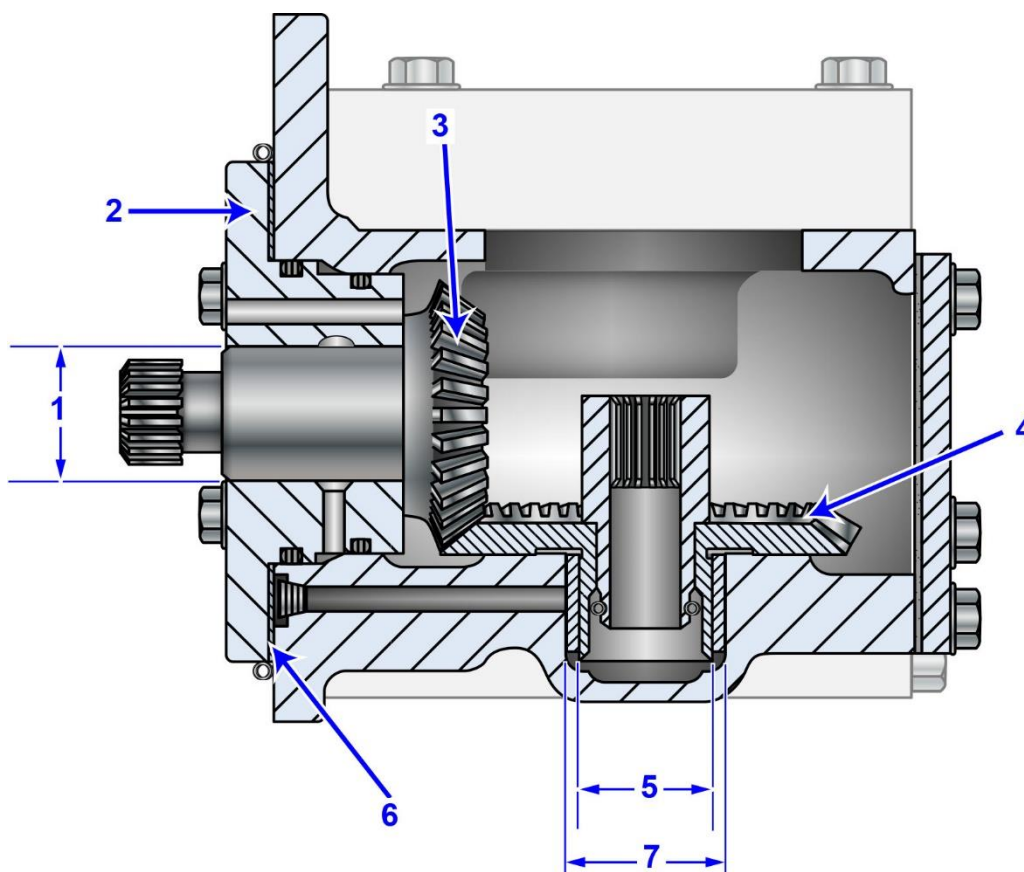
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MO-0091



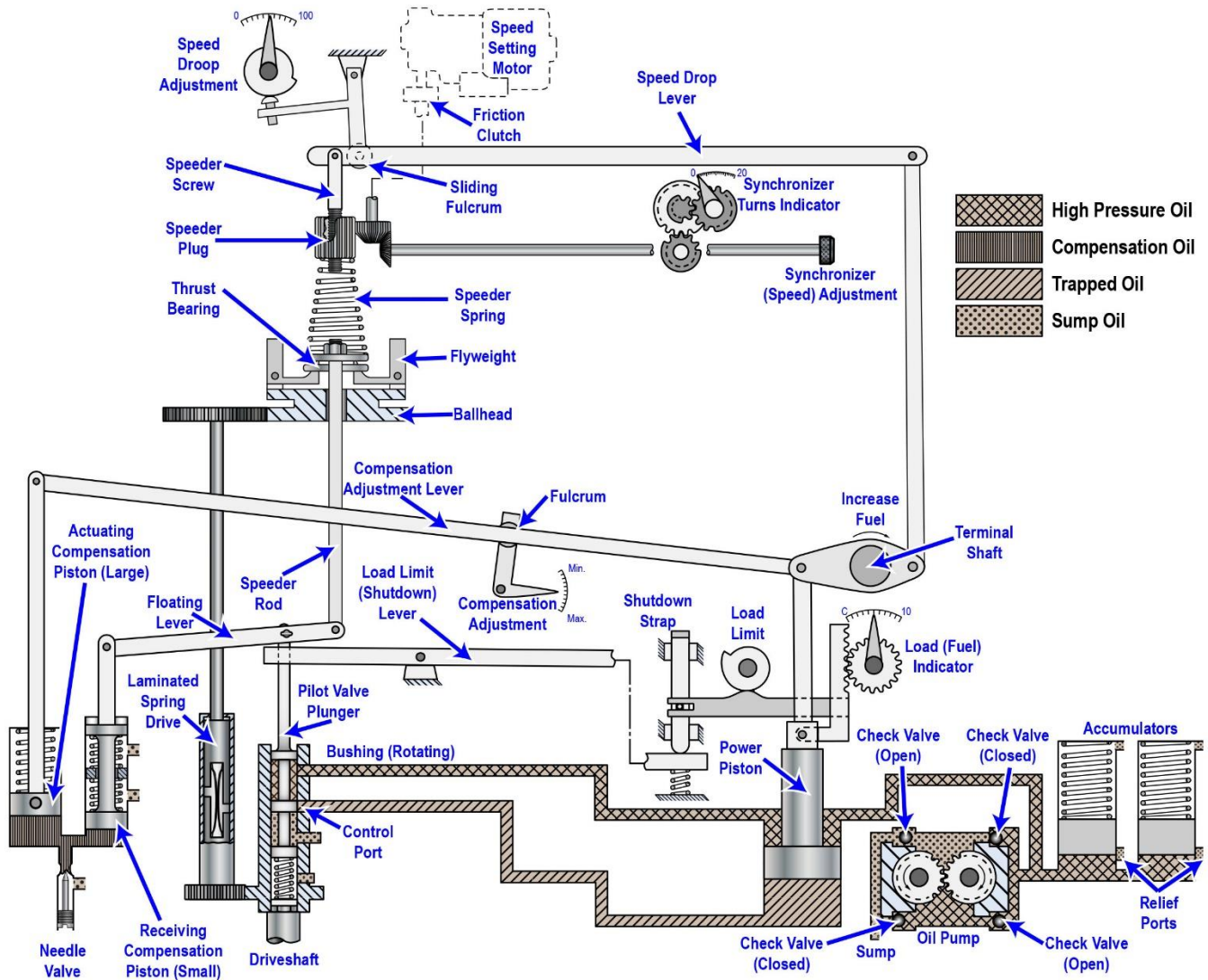
7N1889 & 8N9662 Drive Groups Used With UG8-L Woodward Governors 1W2135 Drive Group Used With Caterpillar 3161 Governors

1. Diameter of bore in adaptor (2) 34.072 ± 0.025 mm (1.3414 ± .0010 in.)
Diameter of shaft on governor drive pinion (3) 34.000 ± 0.013 mm (1.3386 ± .0005 in.)
2. Adaptor
3. Governor drive pinion
4. Bevel gear
5. Diameter of shaft on bevel gear (4)..... 34.000 ± 0.013 mm (1.3386 ± .0005 in.)
Diameter of bore in bearing after assembly in drive housing ... 34.072 ± 0.039 mm (1.3414 ± .0015 in.)
6. Shims. Use as required to get a gear clearance (backlash)
between pinion (3) and gear (4) of..... 0.100 + 0.050 or -0.025 mm (.0039 = 0.020 or -
.0010 in.)
7. Diameter of bore in drive housing 40.432 ± 0.025 mm (1.5918 ± .0010 in.)
Diameter of bearing 40.545 ± 0.013 mm (1.5963 ± .0005 in.)

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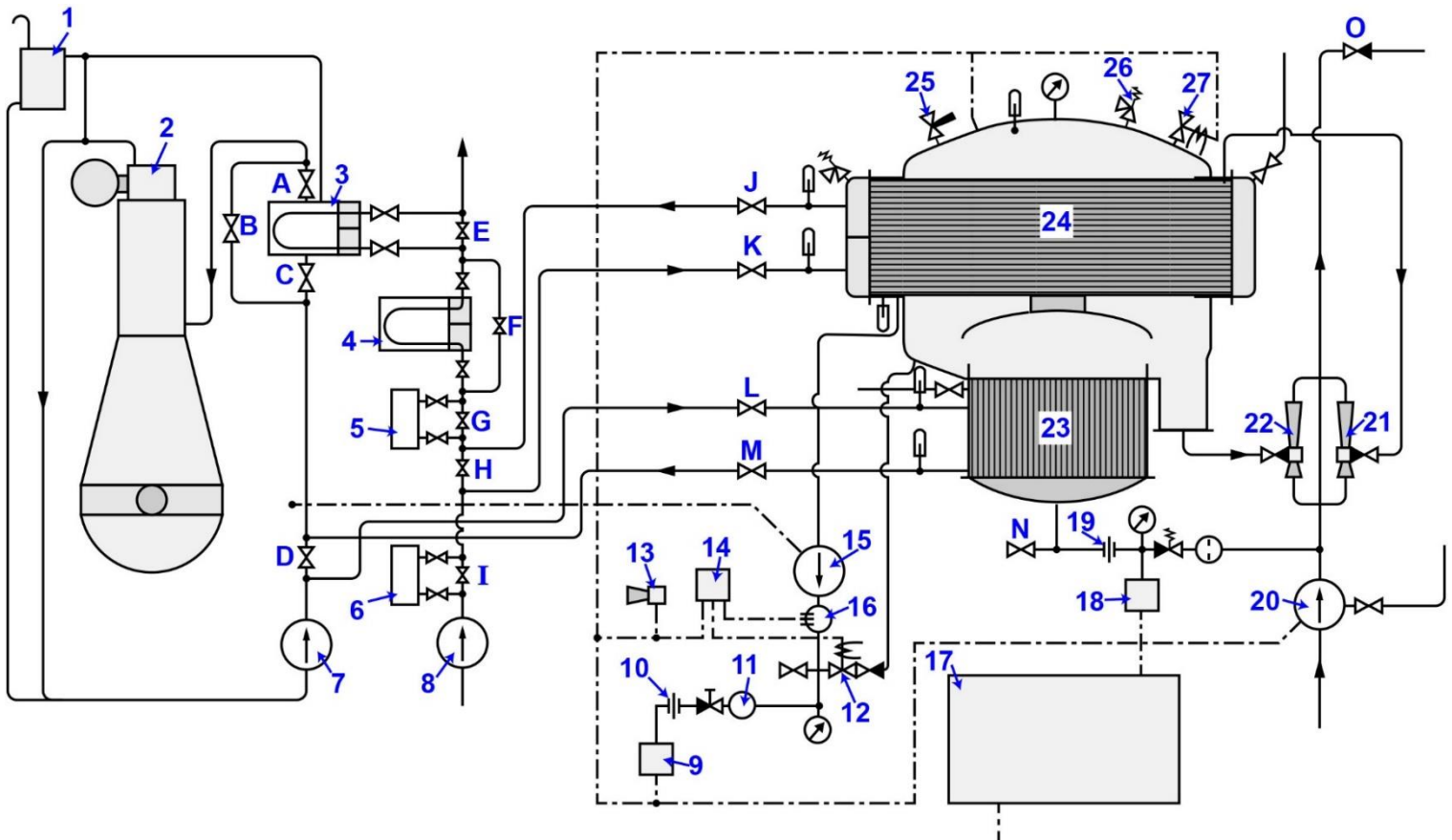
MO-0092



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MO-0111

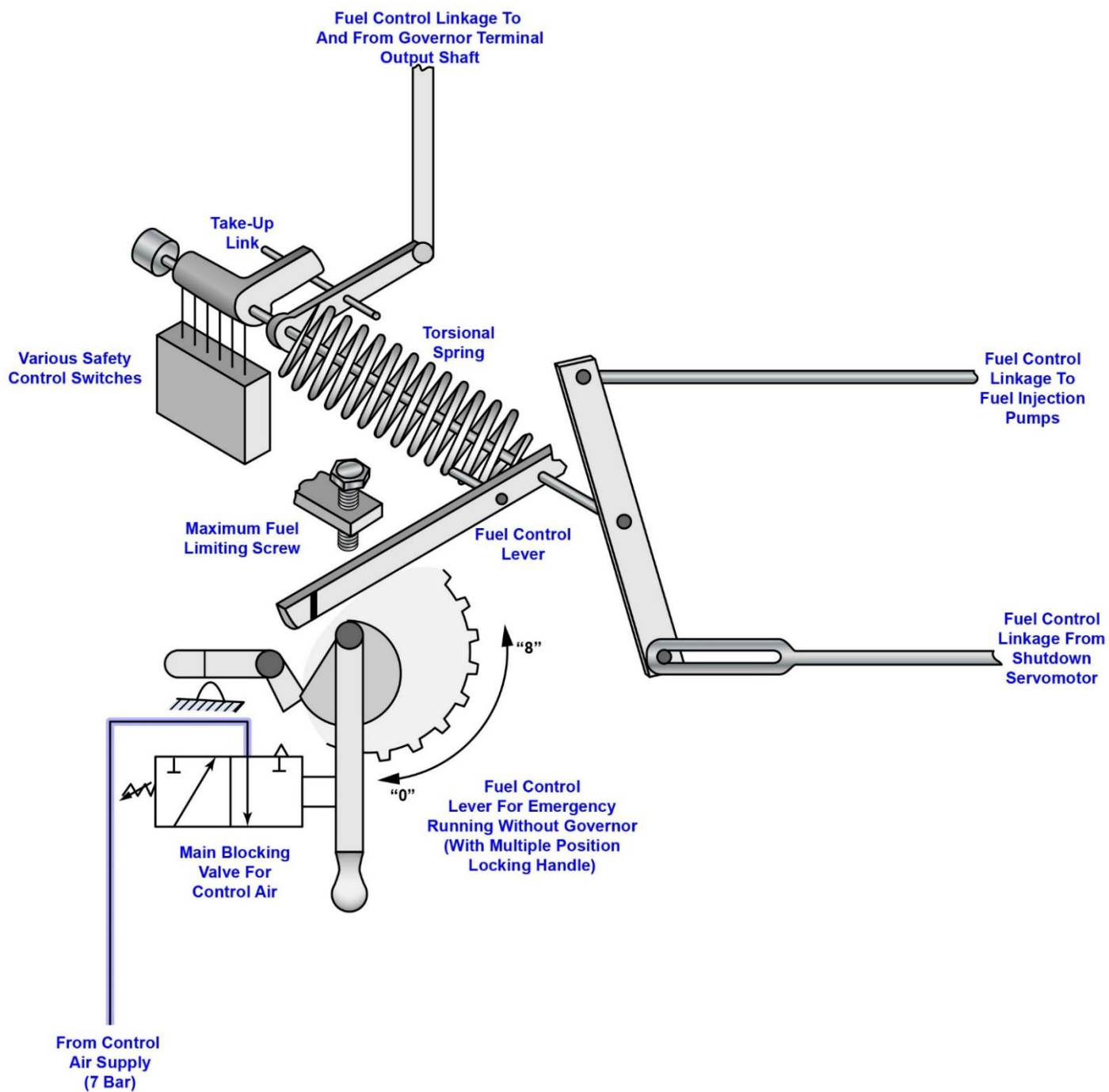


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MO-0119

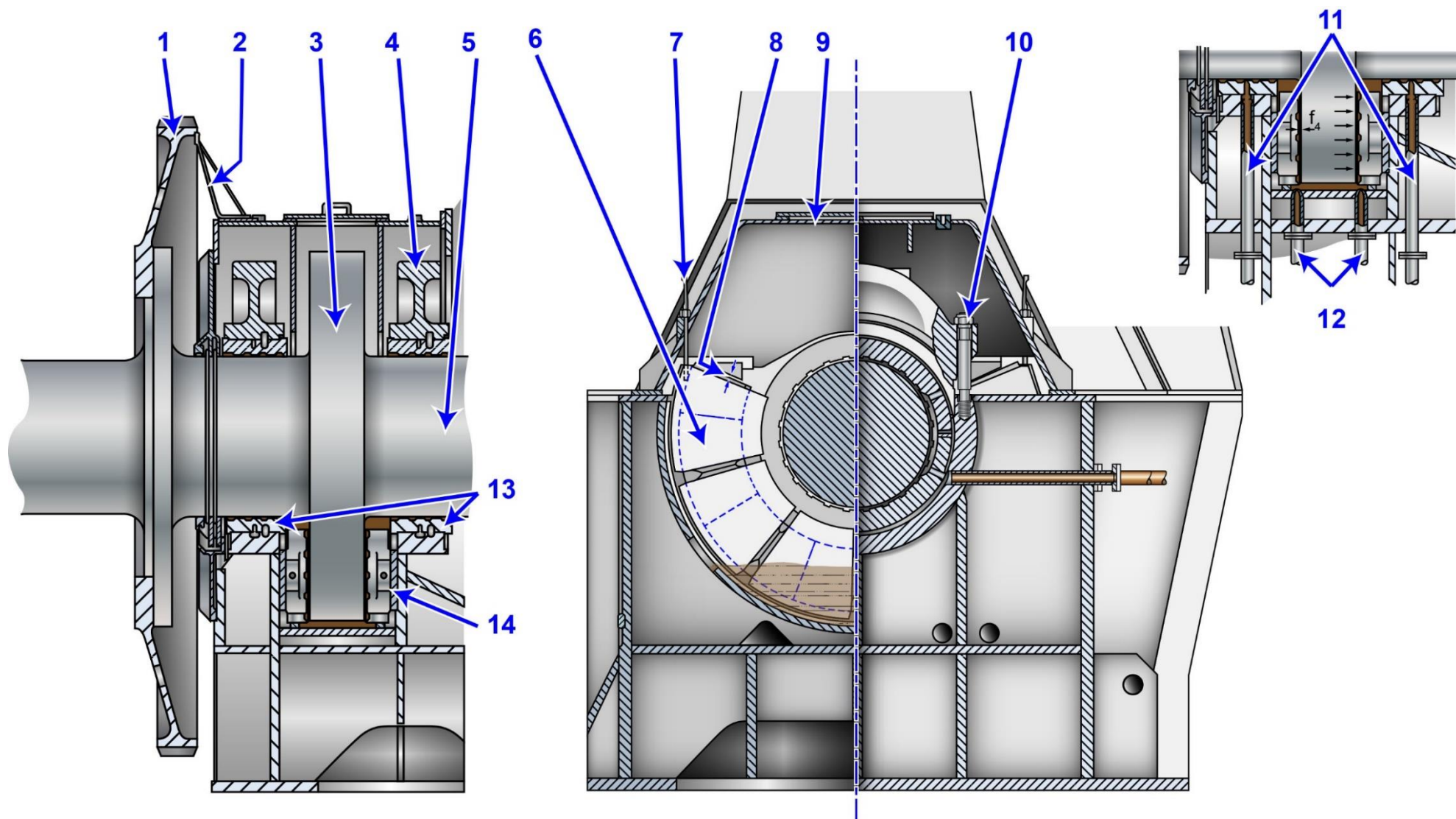
Fuel Control Linkage Arrangement



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MO-0120



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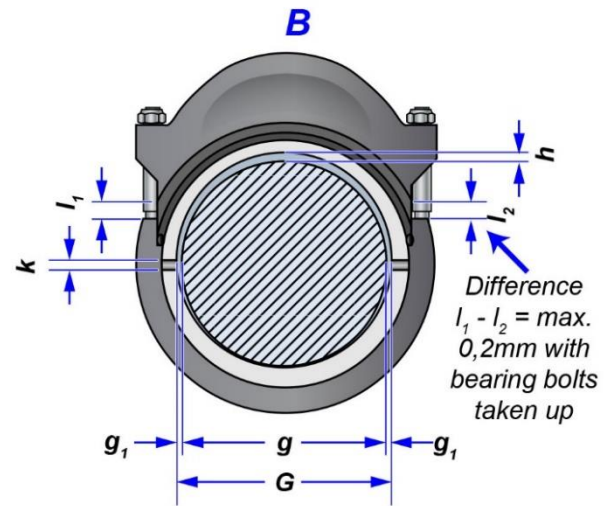
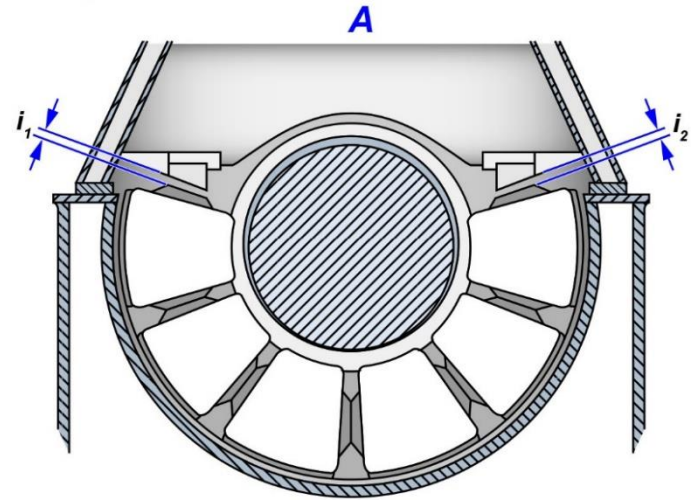
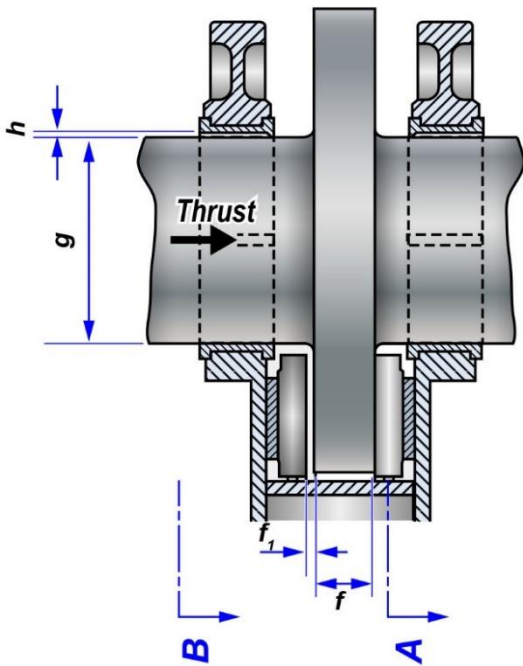
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MO-0121

Thrust Bearing



Nominal dimension	Normal play	Max. play (worn)
$f = 200$	$f_1 = 1,0$	2,0
$g = 540 \begin{matrix} +0 \\ -0,08 \end{matrix}$	$g_1 = \text{min. } 0,10$	
$G = 540 \begin{matrix} +0,38 \\ +0,30 \end{matrix}$	$h = \begin{matrix} +0,46 \\ +0,30 \end{matrix}$	0,8
	$i_1, i_2 = 5$	
$k = 20$		

RND 68	Principal Clearances Crankshaft and Thrust Bearing	<i>All dimensions in mm</i>	7 354 366 - E
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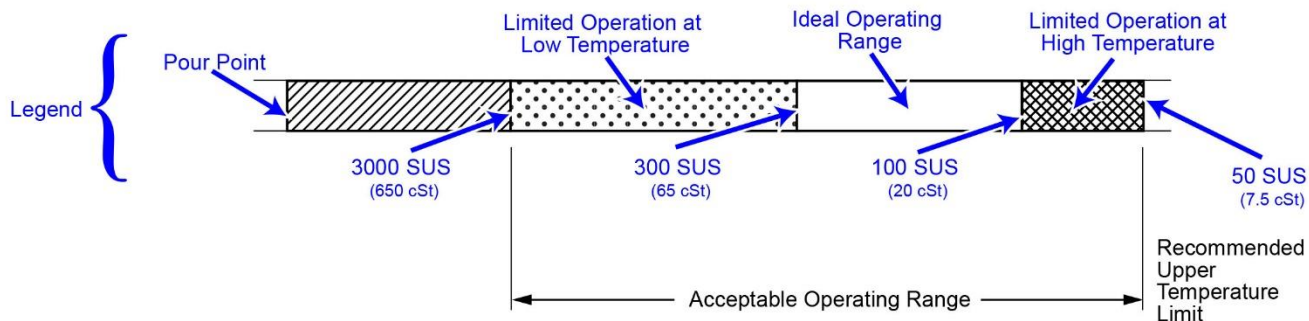


MO-0161 Oil Chart

Recommended Upper Limit of Petroleum Oil is 200°F

Recommended Upper Limit of Synthetic Oil is 250°F

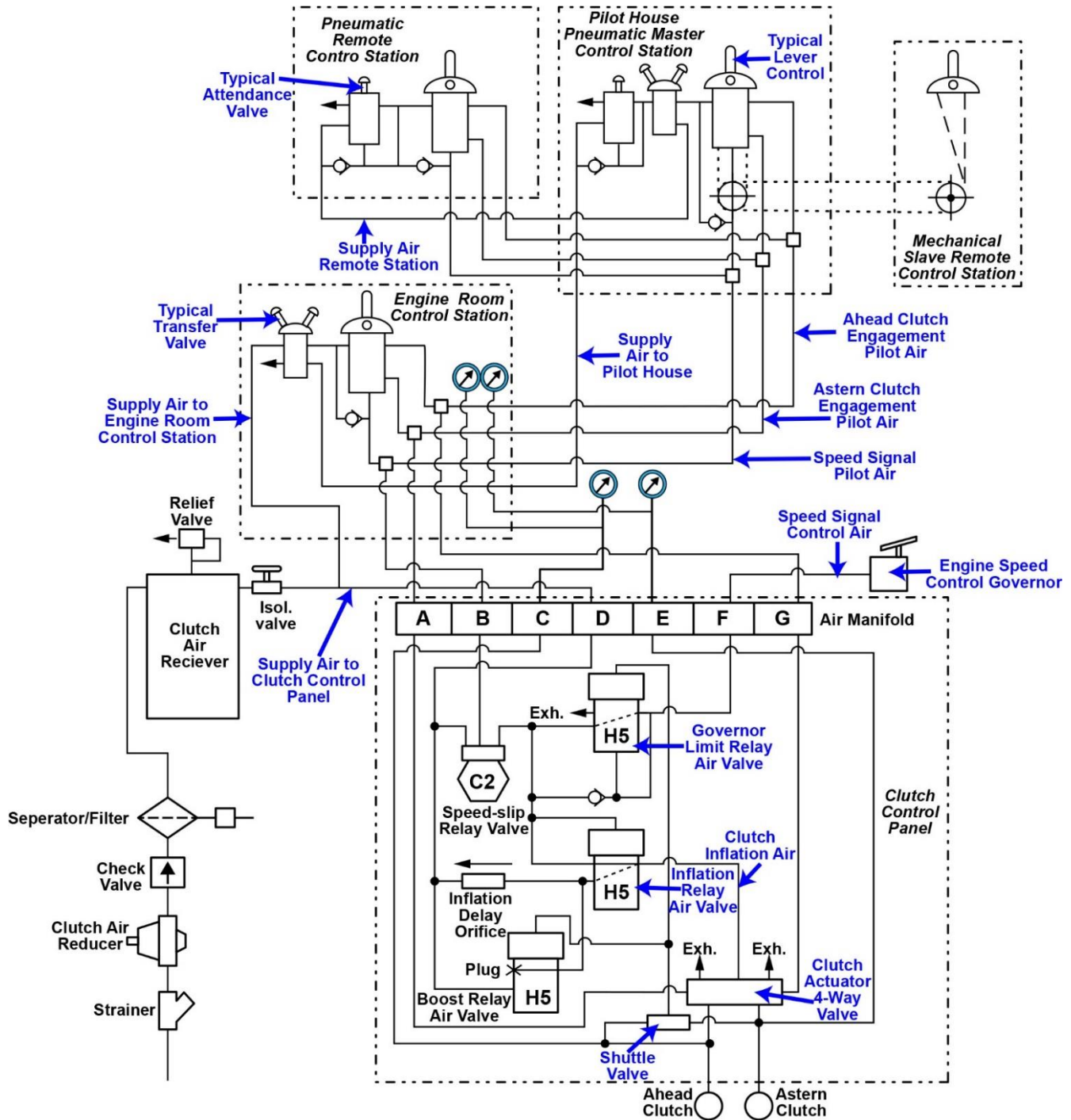
Gov. Oil Operating Temperature	-40°F -40°C	0°F -18°C	40°F 4°C	80°F 27°C	120°F 49°C	160°F 71°C	200°F 93°C	240°F 118°C
Petroleum Oils						SAE 40		
						SAE 30		
						SAE 20		
						SAE 10		
						SAE 10W30		
						SAE 10W40		
						SAE 20W40		
						SAE 15W40		
Auto. Trans. Fluid				Type A-F Dexron II				
Synthetic Oils						All Proof 10W50 (Polyester)		
						Amsoil 10W40 (Diester)		
						DN 600 (Hydrocarbon)		
						Mobil I (Synthesized Hydrocarbon)		
						Delvac I (Synthesized Hydrocarbon)		



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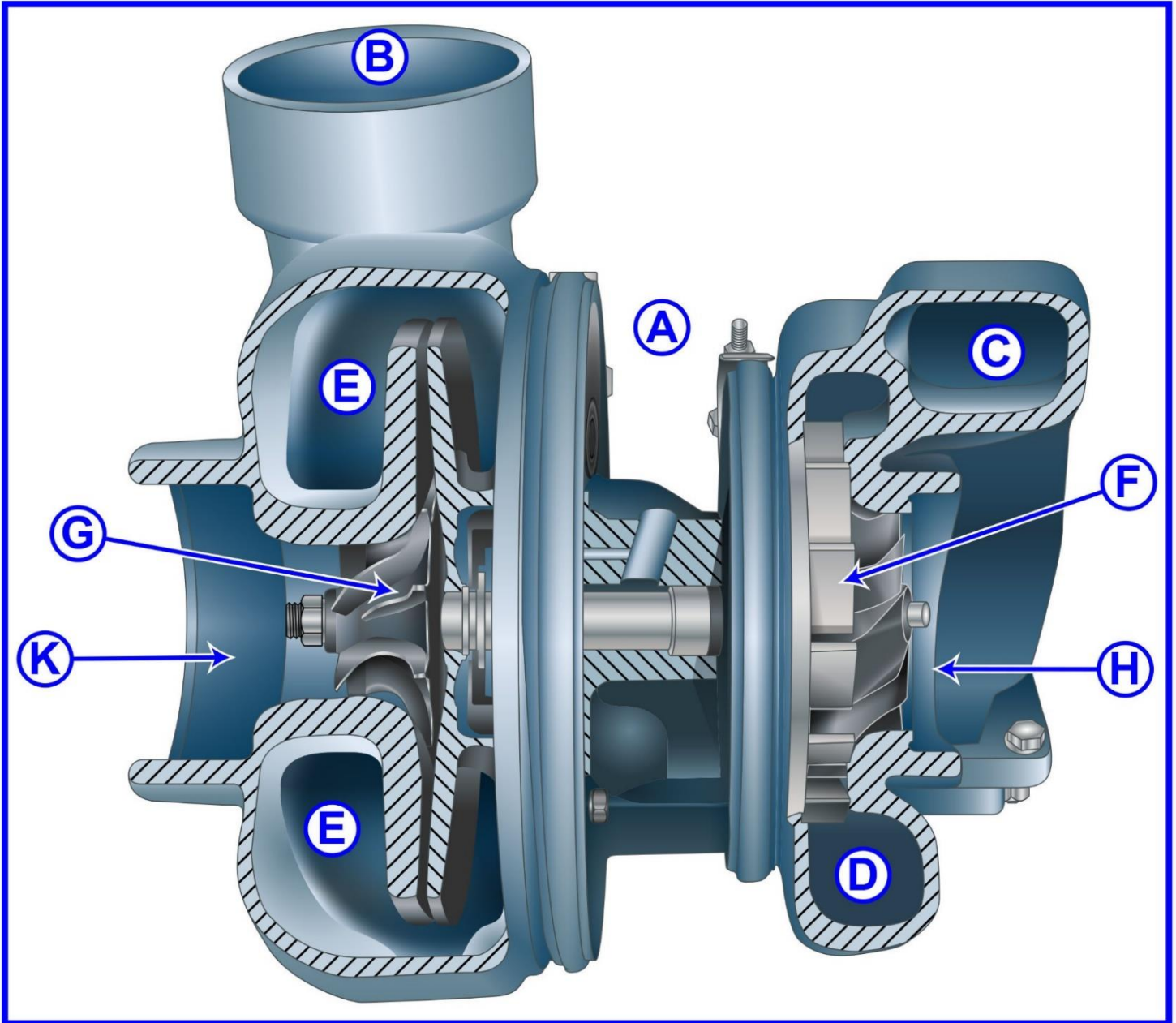
MO-0168 Pneumatic Propulsion Control System



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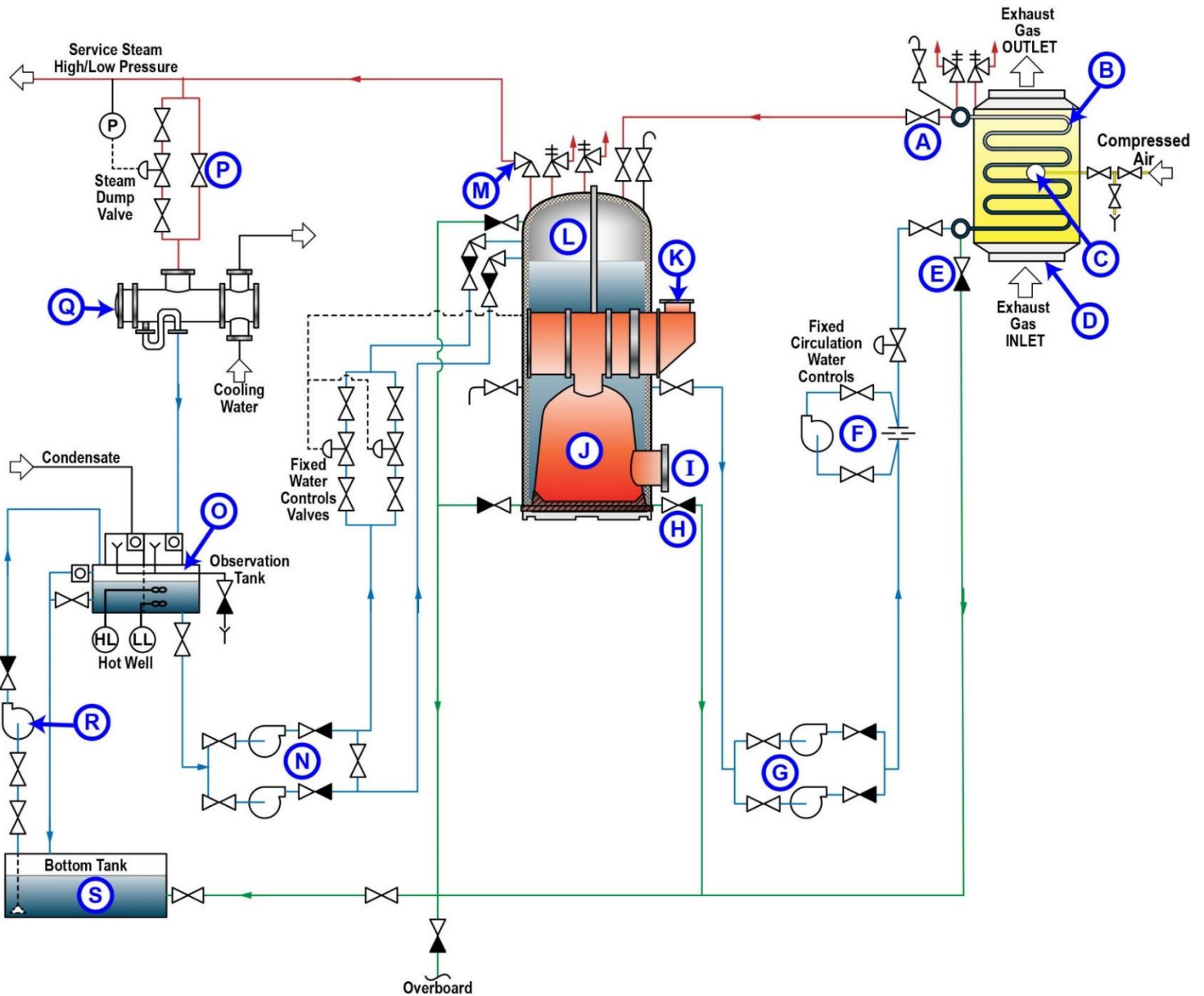
MO-0228



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SG-0004

Table 1
Thermodynamic Properties of
Saturated Steam (Temperature)

Temp, °F	Absolute Pressure, psi	Enthalpy (BTU/lb) of Liquid	Enthalpy (BTU/lb) of Evaporation	Enthalpy (BTU/lb) of vapor
32	0.08859	0.01	1075.5	1075.5
40	0.12170	8.05	1071.3	1079.3
50	0.17811	18.07	1065.6	1083.7
60	0.25630	28.06	1059.9	1088.0
70	0.36310	38.04	1054.3	1092.3
80	0.50690	43.02	1048.6	1096.6
90	0.69820	57.99	1042.9	1100.9
100	0.94920	67.97	1037.2	1105.2
110	1.27480	77.94	1031.6	1109.5
120	1.69240	87.92	1025.8	1113.7
130	2.22250	97.90	1020.0	1117.9
140	2.88860	107.90	1014.1	1122.0
150	3.71800	117.90	1008.2	1126.1
160	4.74100	127.90	1002.3	1130.2
170	5.99200	137.90	996.3	1134.2
180	7.51000	147.90	990.2	1138.1
190	9.33900	157.90	984.1	1142.0
200	11.52600	168.00	977.9	1145.9
212	14.69600	180.00	970.4	1150.4
220	17.18600	188.10	965.2	1153.4
240	24.96900	208.30	952.2	1160.5
280	49.20300	249.10	924.7	1173.8
300	67.01300	269.60	910.1	1179.7
340	118.01000	311.10	879.0	1190.1
380	195.77000	353.50	844.6	1198.1
400	247.31000	375.00	826.0	1201.0

Table 2
Thermodynamic Properties of
Saturated Steam (Pressure)

Absolute Pressure, psi	Temp, °F	Enthalpy (BTU/lb) of Liquid	Enthalpy (BTU/lb) of Evaporation	Enthalpy (BTU/lb) of vapor
0.5	79.58	47.6	1048.8	1096.4
1.0	101.74	69.7	1036.3	1106.0
5.0	162.24	130.1	1001.0	1131.1
10.0	193.21	161.2	982.1	1143.3
14.7	212.00	180.0	970.4	1150.4
15.0	213.03	181.1	969.7	1150.8
20.0	227.96	196.2	960.1	1156.3
25.0	240.07	208.5	952.1	1160.6
30.0	250.33	218.8	945.3	1164.1
40.0	267.25	236.0	933.7	1169.7
50.0	281.01	250.1	924.0	1174.1
60.0	292.71	262.1	915.5	1177.6
70.0	302.92	272.6	907.9	1180.6
80.0	312.03	282.0	901.1	1183.1
90.0	320.27	290.6	894.7	1185.3
100.0	327.81	298.4	888.8	1187.2
110.0	334.77	305.7	883.2	1188.9
120.0	341.25	312.4	877.9	1190.4
130.0	347.32	318.8	872.9	1191.7
140.0	353.02	324.8	868.2	1193.0
150.0	358.42	330.5	863.6	1194.1
200.0	381.79	355.4	843.0	1198.4
250.0	400.95	376.0	825.1	1201.1
300.0	417.33	393.8	809.0	1202.8
350.0	431.72	409.7	794.2	1203.9
400.0	444.59	424.0	780.5	1204.5

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